Automated Vertical Reference

NOTE: The Solicitations and topics listed on this site are copies from the various SBIR agency solicitations and are not necessarily the latest and most up-to-date. For this reason, you should use the agency link listed below which will take you directly to the appropriate agency server where you can read the official version of this solicitation and download the appropriate forms and rules.

The official link for this solicitation is:
https://www.fbo.gov/index?s=opportunity&mode=form&id=35d644c4794ce7203151552e947505d3&tab=core&_cview=1

Agency:
Department of Commerce

Release Date:
November 13, 2013
Branch:
n/a

Open Date:
November 13, 2013
Program / Phase / Year:
SBIR / Phase I / 2014

Application Due Date:
January 29, 2014

Solicitation:
NOAA-2014-1

Close Date:
January 29, 2014
Topic Number:
8.1.2N

Description:

Summary: We are aware of research grade products yielding millimeter per year motions for dam deformation and continental drift. Others are able to generate dynamic vertical positioning on buoys to within 3-5 cm. Between these two ranges we believe there exist the capability to develop and operationally observe vertical stability (lack of change) at a sub-centimeter resolution.

A small, easily-deployable Global Navigation Satellite System (GNSS) based instrument that resolves sub-centimeter vertical and horizontal position in earth centered, earth fixed (ECEF) coordinates has a number of valuable applications. Such a system would be an as-self-contained-as-possible altimeter and positioning system with autonomous processing capabilities. It could be collocated and affixed to existing Center for Operational Oceanographic Products and Services (CO-OPS)1 National Water Level Observation Network (NWLON)2 and land-based sensors to increase temporal identification of vertical site movement. NWLON water level sensor elevation would be precisely measured relative to the GNSS sensor elevation and would provide an additional frame of reference, independent of the geodetic benchmarks.

Other potential applications include integration with a quick-deployable land-based water level sensor (i.e. microwave water level) for storm surge measurements and real-time leveling during extreme events such as tsunamis at hardened sites. Applications of a more dynamic (non-static)

nature such as deployment on buoys of opportunity in support of modeling and water level gauging are also of interest.

Project Goals: The goal is to provide vertical control for a variety of applications. In addition to monitoring NWLON platform stability over the long-term and reducing the frequency of required leveling between the water level sensor and the primary benchmark, this system will add value to the national network of observing systems and increase spatial coverage of vertically controlled stations. Implementation of this technology supports NWLON programmatic goals for precise connections to geodetic and ellipsoidal reference frames for coastal surveying and engineering applications.

Requirements for this innovative product are that it be a small, self-contained, automated, and quickly-deployable system that is cost-effective and consumes minimal power. Kinematic operational scenarios range from the "static" to those associated with the dynamic water surface. The continuous monitoring of the sub-centimeter vertical stability of a "fixed" water level sensor platform (microwave or acoustic) as deployed by CO-OPS represents the normal and satisfactory (nominal) performance scenario3,4. The nominal system must deliver a horizontal and vertical position at least once a day when polled by a data collection platform via RS-232. The device must output the period of observational time and the vertical uncertainty associated with each position report. An explicit error code should be output when the device is unable to deliver sub-centimeter accuracy. The accuracy threshold must be easily adjustable by the user to accommodate environments where the regularized (mean) position solution uncertainty exceeds the sub-centimeter level due to kinematics.

During nominal operations, output from the device will be transmitted along with each six minute microwave or acoustic water level observation, but the reported vertical position will be representative of the elevation acquired over whatever period is necessary to achieve sub-centimeter precision. Any additional encoding of the output for integration into the Geostationary Operational Environmental Satellite (GOES) transmitted message will be conducted by CO-OPS and is not a part of this SBIR topic.

Through novel use of GNSS [GPS, coupled with other systems; e.g., Global Navigation Satellite System (GLONASS)] and other sensor technology, the successful vendor might achieve the Project Goals by: 1) limiting location solutions to constellations which yield the best vertical dilution of precision, 2) enabling advanced filtering and statistical techniques over periods as necessary, 3) starting with the presumption that the receiving antenna is fixed, 4) employing nearby Continuously Operating Reference Station (CORS) stations or satellite based corrections, and 5) focusing on relative position change. Note that even in "static" conditions, solutions which utilize precise point positioning GNSS techniques (as opposed to differential GNSS) must not ignore the sub-daily displacements relative to the ECEF reference frame due to solid earth tides5. One notion of meeting the goals of being self-contained and cost-effective is to avoid reliance upon an external subscription-based augmentation service which involves recurring fees.

Phase I Activities and Expected Deliverables: A Phase I result would include, at minimum:
• A description of the GNSS signal processing that enables the system to provide the required vertical accuracy
• A demonstration of the system capability using real GPS data (not necessarily in real-time or with a field deployable system)
• A description of the hardware, firmware and software that would be developed in a Phase II SBIR

Phase II Activities and Expected Deliverables: A Phase II result would include, at minimum:
• A mutually acceptable two-way data interface (polled RS232, National Marine Electronics Association (NMEA) output)
• Output that includes a measure of position quality and sufficient metadata
• Five (5) fully functional prototypes that would be property of NOAA/NOS. Field testing should include deployment of prototypes in at least three different environments.